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Feasibility Study of the Light Harvesting Aggregate LH-2

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Beamline(s): X21

Introduction: We propose a long-range program to measure $S(\mathbf{q},\omega)$ from the Antenna complex LH-2 of purple bacteria. Purple bacteria obtain their energy through a highly efficient and ingenious light harvesting system. Light is first absorbed by a circular aggregate of bacteriochlorophyll molecules and carotenoids held together by proteins. This aggregate is known as LH-2. Energy is then transferred to a circular antenna complex surrounding the reaction center (LH-1) and finally to the reaction center itself where charge separation occurs [1,2]. In this initial feasibility study, we aimed to determine the lifetime of LH-2 due to radiation damage.

Methods and Materials: Solutions containing LH-2 were prepared in Glasgow and shipped under dry ice to NSLS. Samples of containing frozen LH-2 were transferred to Lindeman glass capillaries and frozen in a stream of liquid nitrogen. A given sample was exposed to the X-ray beam for a pre-determine amount of time. The inelastic scattering was attempted simultaneously, but the signal was obscured by the air scattering, as expected. A full set of samples with various exposure time were then shipped to the University of Houston under dry ice where their optical absorption spectrum was measured. A peak in the optical absorption at 858 nm would indicate that the LH-2 was undamaged by X-ray exposure.

Results: An LH-2 sample can endure a 5-hour exposure to the wiggler photon flux at X21 at 7.9keV, with its optical absorption spectrum after exposure virtually identical to that without X-ray exposure. It is important that the LH-2 must be cooled to liquid nitrogen temperatures.

Conclusions: This feasibility study shows that it is possible to study the electronic excitations in the LH-2 organic aggregate using inelastic X-ray scattering. Single crystals are now in preparation [3].

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References:

1. G. McDermott, S. M. Prince, A. A. Freer, A. M. Hawthornthwaite-Lawless, M. Z. Papiz, R. J. Cogdell and N. W. Isaacs, Nature 374, 517 (1995).
2. M.G. Cory, M.C. Zener, X. Hu and K. Schulten, J. Phys. Chem B 102, 7640 (1998).
3. TD Howard, KE McAuley, & RJ Cogdell, Crystallization of Membrane Proteins, in Membrane Transport, (S. Baldwin, ed.), p p. 269-307, Practical Approach Series, Oxford University Press, Oxford (2000).